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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/833,372	04/12/2001	Michael Wojtowicz	12-1100	3137

7590 03/19/2004

Patent Counsel
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EXAMINER

BAUMEISTER, BRADLEY W

ART UNIT	PAPER NUMBER
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2815

DATE MAILED: 03/19/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/833,372

Applicant(s)

WOJTOWICZ, MICHAEL

Examiner

B. William Baumeister

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 20 January 2004.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5 and 8-11 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5 and 8-11 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Response to Arguments

1. In view of the Appeal Brief filed on 1/20/2004, PROSECUTION IS HEREBY REOPENED. The new rejection of the claims set forth below.

To avoid abandonment of the application, appellant must exercise one of the following two options:

- (1) file a reply under 37 CFR 1.111 (if this Office action is non-final) or a reply under 37 CFR 1.113 (if this Office action is final); or,
- (2) request reinstatement of the appeal.

If reinstatement of the appeal is requested, such request must be accompanied by a supplemental appeal brief, but no new amendments, affidavits (37 CFR 1.130, 1.131 or 1.132) or other evidence are permitted. See 37 CFR 1.193(b)(2).

Claim Rejections - 35 USC § 103

2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

3. Claims 1, 8 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Song '944 in view of either one of JP 4-251934 (cited previously, English translation enclosed) or alternatively JP 63-248164 (previously made of record).

- a. Song generally discloses a GaN-based HBT (see FIG 3): on a substrate 5 is formed an n+ GaN subcollector 3; an n- GaN collector; a p+ GaN base; a relatively wider

bandgap n AlGaN emitter; and contacts formed on the subcollector, base and emitter, respectively. The claims are not anticipated because Song does not disclose an AlGaN/GaN superlattice employed for the base.

b. JP '934, see e.g., FIG. 1B, teaches an InP/InGaAs HBT which includes a wide-bandgap InP emitter; a more narrow-bandgap InGaAs collector; and a base composed of a CHIRPed InP/InGaAs superlattice (the same materials employed for that HBT's emitter and collector, respectively) with an effective bandgap that decreases from the emitter side to the collector side for the purpose of increasing the carrier drift, and therefore decreasing the transfer time, within the base region, thereby increasing the HBT's speed (see e.g., paragraph [0005]).

c. JP '164 teaches an AlGaAs/GaAs HBT which includes a wide-bandgap AlGaAs emitter; a more narrow-bandgap GaAs collector; and a base composed of a CHIRPed (Al)GaAs superlattice (the same materials employed for that HBT's emitter and collector, respectively) with an effective bandgap that decreases from the emitter side to the collector side for the purpose of increasing the carrier drift, and therefore decreasing the transfer time, within the base region, thereby increasing the HBT's speed (e.g., English Abstract).

d. It would have been obvious to one of ordinary skill in the art at the time of the invention to have employed within Song's (Al)GaN HBT, a CHIRPed superlattice base formed of the same materials employed for that HBT's emitter and collector (i.e., AlGaN and GaN), respectively, as taught by either one of JP '934 or JP '164 for the purpose of producing an electric field that increases the carrier drift, and therefore decreases the

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carrier transfer time across the base, thereby increasing the speed of Song's (Al)GaN HBT. It would have been further obvious to the skilled artisan to have specifically employed AlGaN and GaN in such a base superlattice because (1) JP '934 and JP '164 each teaches that the base superlattice may be composed of the two particular materials that are employed for the emitter and the collector; (2) Song discloses that AlGaN and GaN, in particular, may be employed for the emitter and collector, respectively; and (3) because using these specific materials in the superlattice would enable good lattice matching between the emitter, base and collector.

8. Claim 5 is rejected--and claims 1, 8 and 9 are alternatively rejected--under 35 U.S.C. 103(a) as being unpatentable over either Song/JP '934 or alternatively Song/JP '164 as applied to the claims above, and further in view of Razeghi '277 (previously made of record in IDS #2).

a. As explained above, JP '934 and JP '164 provides motivation for *why* one would have wanted to employ an AlGaN/GaN superlattice in the base region of Song's (Al)GaN HBT. Assuming *arguendo* that Song, JP '934 and JP '164 must be read so narrowly as not sufficiently teaching that one actually *could* form a p+doped superlattice of AlGaN/GaN, Razeghi provides further evidence that it was known at the time of the invention by those skilled in the art how to form a p+ AlGaN/GaN superlattice. Thus, it would have been further obvious to form a base superlattice from the specific materials of AlGaN/GaN because these are the materials specifically employed in the various regions of Song, and Razeghi teaches how to form a superlattice using these materials.

b. Regarding claim 5, Song does not disclose what particular materials may be used

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for the substrate on which the GaN-based HBT is grown. Razeghi teaches that sapphire or SiC may be employed as a substrate for GaN-based devices thereover (col. 3). It would have been obvious to one of ordinary skill in the art at the time of the invention to have employed sapphire or SiC for the substrate as taught by Razeghi because these are the two primary substrate materials used for GaN-based device due to lattice-matching issues.

9. Claims 2-4, 10 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over the prior art as applied to the claims above, and further in view of Ohta et al. 206.

a. The claims mentioned in the previous paragraphs set forth a superlattice (i.e., a structure having an irregular band gap energy), but do not further require that the AlGa_N barriers be graded across the superlattice (i.e., do not require the barrier Al content to decrease from the emitter towards the collector). As such, the claims previously mentioned read on either Song/JP '934 or alternatively Song JP '164 as explained above because the two Japanese references each teach at least that the CHIRP-graded superlattices may be formed specifically by varying the respective thicknesses of the barriers and wells (i.e., wherein the respective barrier and well compositions remain unchanged, but their successive, respective thicknesses are altered).

b. Claims 2-4, 10 and 11 do set forth the further limitation that the CHIRPed base have graded-composition barriers. Regardless of whether either of JP '934 or JP '164 additionally teach the alternative use of CHIRPed superlattices that are specifically barrier-composition-graded instead of thickness-graded to produce the effective change

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in the base's bandgap, Ohta teaches that either barrier-thickness-grading or barrier-composition-grading can be employed in CHIRPed superlattices to produce effective band-gap changes in superlattice structures (see e.g., FIGs 14-21). Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to have employed barrier-graded CHIRPing as taught by Ohta instead of the thickness-graded CHIRPing in the CHIRPed superlattice HBT taught by Song/JP '934, or alternatively Song/JP '164, because the two CHIRP-grading schemes are functional equivalents, both conventionally known at the time of the invention and because barrier-grading enables the use of constant thickness (i.e., thinner) barrier and well layers, and does not require taking into account the change of each barriers' and wells' respective thicknesses for design calculations.

Response to Arguments

4. Applicant's arguments, see Appeal Brief, filed 1/20/2004, with respect to the rejection(s) of the claim(s) have been fully considered and are partially persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made as set forth above.

a. Applicant's arguments relating to the base-emitter conduction-band alignment issue are persuasive. Applicant further asserted in the Appeal Brief that that the GaN-based heterojunctions bipolar transistor (HBT) of the Song patent is different from the present invention for two reasons: (1) the p⁺ doped base of Song is composed of GaN instead of a graded AlGa_N/Ga_N superlattice; and (2) the Song patent discloses a two-

layer emitter with one layer formed from AlGaN and a second layer formed from GaN, whereas the invention discloses a homogenous emitter layer formed from AlGaN.

- i. The examiner agrees with the first assertion; that is why the claims were not rejected as being anticipated by Song, but are alternatively rejected as being obvious over Song further in view of either JP '934 or JP '164 (and Razeghi and/or Ohta). This first difference was addressed hereinabove.
- ii. Turning to Applicant's second argument, it is immaterial to the rejection that Song's HBT has a two-layer emitter structure. The claims set forth an HBT comprising, *inter alia*, an AlGaN emitter, and an emitter contact formed on said emitter (see e.g., claim 1). The lower, AlGaN layer of Song's two-layer emitter structure reads on the AlGaN emitter layer set forth in the claims. Also, because the claims employ the transition word, "comprising," the claims do not limit the invention to an emitter having only a single emitter layer, but rather, allow for the presence of additional layers, such as Song's additional, second GaN layer.

Moreover, the claims' term, "emitter contact," has two conventional meanings within the art: (1) an interposed, doped semiconductor contact layer that improves electrical/ohmic contact between a semiconductor emitter layer and a metal electrode/contact; or alternatively (2) the metal electrode/contact, itself, regardless of whether a semiconductor contact is also employed. Under the former interpretation, Song's upper, GaN emitter layer reads on the claimed "emitter contact" because, as the skilled artisan would readily understand, the GaN layer improves the electrical/ohmic contact between the lower AlGaN

emitter layer and the superposed metal electrode/contact as GaN has a smaller bandgap and lower conduction band energy level than does AlGa_N. Restated, it is immaterial whether Song's second, GaN layer of the emitter structure is labeled as "a second emitter layer" or alternatively as "an emitter contact layer;" due to the physics of the AlGa_N/GaN heterojunctions, the GaN layer, in fact, functions as "an emitter contact formed on said emitter."

Alternatively, under the latter interpretation of "emitter contact," Song's lower, AlGa_N emitter layer reads on the claimed AlGa_N emitter layer, and Song's n-type metal layer reads on the claims' limitation of "an emitter contact formed on said emitter" because the claims do not require that the emitter contact be formed directly on the emitter, thereby permitting the presence of Song's additionally interposed GaN emitter layer. **To summarize, Appellant's argument that Song's emitter structure differs from the present invention's emitter structure is not persuasive because, regardless of which claim interpretation is adopted, Song's emitter/emitter-contact structure reads on the invention's emitter/emitter-contact structure, as claimed.**

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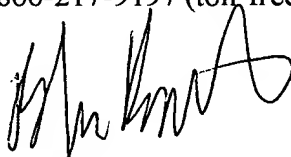
Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to B. William Baumeister whose telephone number is (571) 272-1722. The examiner can normally be reached on M-F 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (571) 272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

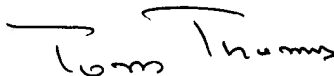
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**B. WILIAM BAUMEISTER
PRIMARY EXAMINER**



B. William Baumeister
Primary Examiner
Art Unit 2815

March 13, 2004



Tom Thomas
Supervisor
Art Unit 2815